DEPR:
The top thin plate 11a is put on the top of the yoke 1 constituted by stacked thin plates 11, and the end plate 16 is secured to the open end of the yoke 1. With magnetized permanent magnets (see numeral 5 in FIG. 1) attracted to the yoke 1 at predetermined positions, the yoke 1 is inserted into a die, and a thermoplastic resin such as polyphenylene sulfide, polycarbonate, unsaturated polyester, liquid-crystal plastics or other engineering plastics is injected into the die to mold the resin integrally with the yoke 1 and the permanent magnets 5 except for outer surfaces of the end plate 16. The resultant covering not only prevents corrosion of surfaces of the respective components (yoke 1 and permanent magnets 5) but also prevents relative movements of the respective components. After inserting the center yoke portion 2 into the movable coil 8 of the arm 7, the counter yoke 4 is secured to the end plate 16 attached to the open end of the yoke 1.

DEPR:
The permanent magnets in the form of an arc segment or a hollow cylinder used in the present invention may be fabricated in the following manner: First, the R-Fe-B alloy is molten in argon (Ar) or in vacuum by a normal method. B may be added in the form of ferroboron. Rare earth elements are preferably added last. The resultant ingot is crushed and milled. The crushing may be carried out by stamping mills, jaw crushers, Brown mills, disk

FIG.1

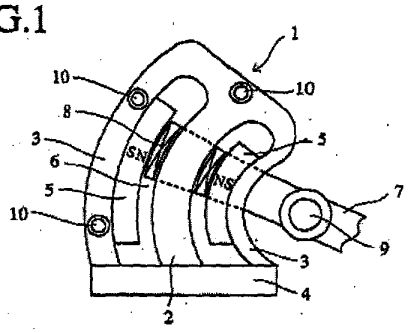
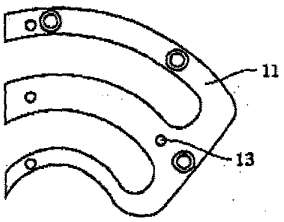


FIG.2



EAST Browser - L32: (15) 31 and 28 | US 6274962 | Tag: $,T1 | Doc: 3/15 | "Full" 1/11 (Total images 11)

File Edit View Tools Window Help

DOCUMENT-IDENTIFIER: US 6274962 B1
TITLE: Induction motor driven seal-less pump

---------- KWIC ---------

DEPR:
Starting and running performance of a corrosion resistant rotor can be achieved
by pressing or shrink fitting an annulus of electrically conductive, corrosion
resistant material over a solid steel rotor core. For solid steel rotor cores,
there will be skin effects, especially during starting, and corrosion occurs.

CCOR:
310/261

CCXR:
310/216

CCXR:
310/43

CCXR:
310/44

CCXR:
310/45

CCXR:
310/67R

CCXR:
310/87

Details Text Image HTML KWIC

US006274962B1

(12) **United States Patent**
Kliman

(10) **Patent No.: US 6,274,962 B1**
(45) **Date of Patent: *Aug. 14, 2001**

(54) **INDUCTION MOTOR DRIVEN SEAL-LESS PUMP**

(75) Inventor: **Gerald Burt Kliman**, Niskayuna, NY (US)

(73) Assignee: **General Electric Company**, Schenectady, NY (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/347,559**

(22) Filed: **Jul. 6, 1999**

Related U.S. Application Data

(62) Division of application No. 08/766,683, filed on Dec. 13, 1996, now Pat. No. 5,930,586.

(51) Int. Cl.[7] **H02K 1/22**; H02K 15/02; H01K 3/128

(52) U.S. Cl. ..... 310/261; 310/43; 310/64; 310/45; 310/67 R; 310/216; 310/87; 310/156

(58) Field of Search ..... 310/261, 67 R, 310/43, 156, 42, 44, 45, 215, 87; 29/596; 417/423.3, 423.1, 423.7, 410.1; 148/104, 105

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(List continued on next page.)

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57-42339 * 3/1982 (JP) H02K3/44
61-42249 * 3/1982 (JP) H02K/21/08

OTHER PUBLICATIONS

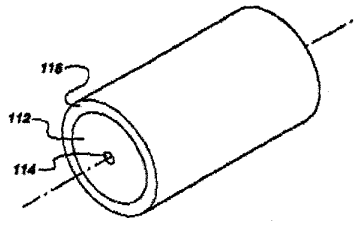
U.S. patent application entitled "Fabrication of Induction Motors" by G. B. Kliman, et al, Ser. No. 08/317,077 filed Oct. 3, 1994.

Primary Examiner—Burton S. Mullins

(57) **ABSTRACT**

A seal-less pump and electric motor assembly includes a motor rotor fixed to a driving shaft connected to an impeller in the pump assembly. The rotor and impeller are enclosed in a common housing such that the rotor rotates within any fluid being pumped by the impeller. The portion of the housing circumscribing the rotor includes a plurality of axially extending, circumferentially spaced strips of magnetic material penetrating through plastic material of the housing. Each of the strips coincide with corresponding ones of the pole teeth of a motor stator circumscribing the outer portion of the housing such that the strips in the housing act as extensions of the pole teeth. In one embodiment, the strips of magnetic material in the housing are formed by molding powdered iron in a plastic binder material. The strips are then placed in a mold in which the housing is formed by injecting plastic. The plastic binder in the strips melds with the injected plastic to form a continuous housing for enclosing the rotor. The ferromagnetic material strips extend through the housing and are spaced from the rotor surface by a normal air gap distance so as to improve the efficiency of the motor by having the magnetic strip act as extensions of the motor stator pole teeth. In one embodiment, the rotor includes a shaft, a core including a molded magnetic powder and plastic composite material surrounding the shaft, and an annular corrosion resistant electrically conductive tube surrounding the core.

6 Claims, 5 Drawing Sheets



Details Text Image HTML Full

Ready NUM

DOCUMENT-IDENTIFIER: US 5990588 A
TITLE: Induction motor driven seal-less pump

---------- KWIC ---------

DEPR:
Starting and running performance of a corrosion resistant rotor can be achieved by pressing or shrink fitting an annulus of electrically conductive, corrosion resistant material over a solid steel rotor core. For solid steel rotor cores, there will be skin effects, especially during starting, and corrosion occurs.

CCOR:
310/86

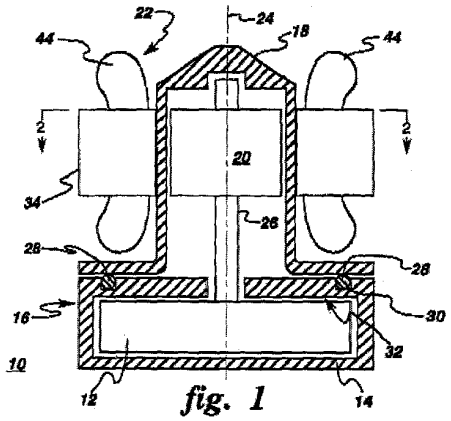


fig. 1

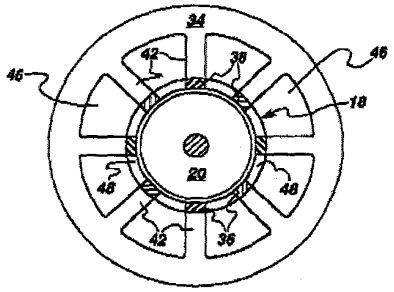


fig. 2

DOCUMENT-IDENTIFIER: US 6141856 A
TITLE: Method of fabricating rotors with retaining cylinders and reduced harmonic field effect losses

---------- KWIC ---------

DEPR:
FIG. 1 is a sectional side view of one embodiment of a rotor of the present invention comprising a shaft 10, a permanent magnet layer 14, and a retainer 12. The shaft comprises a high permeability magnetic metal such as steel having an optional hollow core 18 to increase rotational critical speed and/or permit through flow of a fluid. The retainer often comprises a conductive material having high strength and low magnetic permeability, such as INCONEL.TM. 718 (a trademark of Inco International, Inc. of Huntington, W. Va., for a corrosion-resistant alloy containing primarily nickel, chromium, and iron). The retainer can alternatively comprise a composite of non-conductive materials such as KEVLAR.TM. aromatic polyamide fibers (KEVLAR is a trademark of E.I. duPont de Nemours & Co.). Retainer 12 provides the necessary support for the magnet layer 14 to resist centrifugal forces. In one embodiment the retainer is cylindrical and has a thickness ranging from about 0.04 inches to about 0.12 inches.

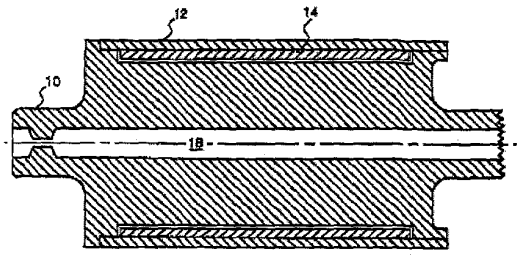


FIG. 1

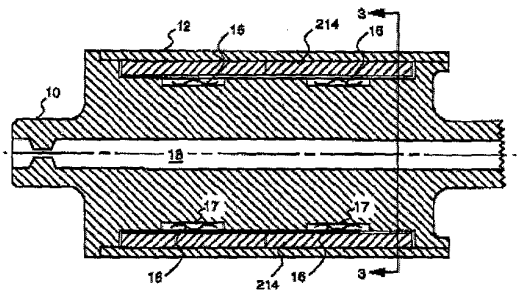


FIG. 2

DEPR:
The motor casing 11 will be described in greater detail with reference to FIG.
2. The barrel 31 comprises a first member 32 made of a material, such as cast iron, cast steel, silicon steel, or the like, which is suitable to provide magnetic characteristics required of the yoke, and a second member 33 made of a highly corrosion-resistant material, the first member 32 being referred to as a "yoke". The second member 33 is in the form of an aluminum pipe and will be referred to as a "pipe". The yoke 32 has a body 32a in the form of a hollow cylinder having a relatively large wall thickness. The body 32a has thinner upper and lower sleeves 32b, 32c at its upper end lower ends, respectively.
The body 32a has a substantially circular cross-sectional shape across the axis thereof and includes a round shoulder 32d (FIG. 3) at each of its upper and lower end portions. Each of the upper and lower sleeves 32b, 32c has an annular groove 34 defined in its portion joined to an end of the body 32a and having a wall surface lying flush with an end surface 32e of the body 32a. The aluminum pipe 33 is fitted over the body 32a to cover the outer peripheral surface thereof and has upper and lower end portions bent radially inwardly into upper and lower flanges 33a, respectively, held closely against the upper and lower end surfaces 32e of the body 32a. The aluminum pipe 33 can be formed from a pipe blank in the form of a plain hollow cylinder

United States Patent [19]
Negishi

[11] **Patent Number: 4,700,093**
[45] **Date of Patent: Oct. 13, 1987**

[54] **CORROSION-RESISTANT MOTOR CASING**

[75] Inventor: **Yoshio Negishi, Saitama, Japan**
[73] Assignee: **Kabushiki Kaisha Showa Seisakusho, Tokyo, Japan**

[21] Appl. No.: **792,683**
[22] Filed: **Oct. 29, 1985**
[30] **Foreign Application Priority Data**
Oct. 29, 1984 [JP] Japan ..... 59-163473[U]
[51] Int. Cl.⁴ H02K 5/00
[52] U.S. Cl. 310/89; 310/42; 310/254
[58] Field of Search 310/42, 45, 89, 88, 310/254, 90

[56] **References Cited**
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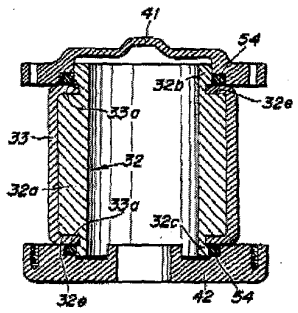
4,528,473	7/1985	Tezuka	310/89

Primary Examiner—Donovan F. Duggan
Attorney, Agent, or Firm—Lowe, Price, LeBlanc, Becker & Shur

[57] **ABSTRACT**

A corrosion-resistant electric motor casing comprises a substantially cylindrical yoke and barrel, and a pair of brackets fixed to and closing the axially opposite ends of the yoke and barrel. The yoke and barrel comprises a first member substantially in the form of a hollow cylinder made of a material which is sufficiently ferromagnetic to serve as a motor yoke, and a second member in the form of a pipe of aluminum fitted over the first member and covering the outer peripheral surface thereof. The motor casing is made highly resistant to corrosion without involving an increase in the weight and cost thereof.

12 Claims, 3 Drawing Figures



EAST Browser - L23: (5) 22 and 18 | US 5793143 | Tag: S,T1 | Doc: 3/5 | "Full" 3/7 (Total images 7)

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BSPR:
One challenge in adding permanent magnets to a Lundell rotor concerns securely mounting the magnets in a manner which will retain the magnets at the high speeds at which an alternator rotor rotates. Another challenge is in protecting the magnets from corrosion while in service in the rotor. Corrosion of permanent magnets is disadvantageous because it reduces the structural integrity and magnetic strength of the magnets. Yet a third challenge in adding permanent magnets to a Lundell rotor involves finding the highest efficiency with which to assemble the rotor, given that several more components are now involved. A fourth challenge involves assuring sufficient cooling for the alternator in light of the additional electrical output which is the goal of adding the permanent magnets in the first place.

BSPR:
Rotors for electrical machines according to various embodiments of the present invention can include embedded permanent magnets and the increased power density and efficiency which the magnets can provide. Further, the design can securely hold the permanent magnets in place, protect against corrosion of the permanent magnets and be assembled with very high efficiency. Rotors according to the present invention can thus provide substantial advantages over alternative designs.

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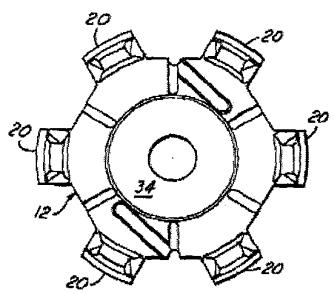

FIG.2A

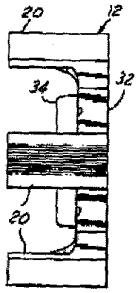

FIG.2B

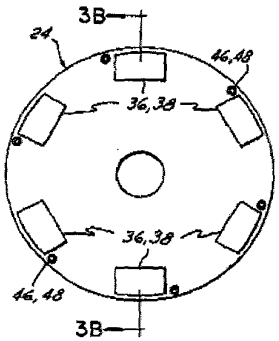

FIG.3A

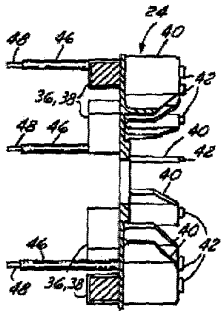

FIG.3B

Details Text Image HTML Full

Ready NUM

09/972928

10/10/01

embodiments of the present invention can include embedded permanent magnets and the increased power density and efficiency which the magnets can provide. Further, the design can securely hold the permanent magnets in place, protect against corrosion of the permanent magnets and be assembled with very high efficiency. Rotors according to the present invention can thus provide substantial advantages over alternative designs.

DEPR:
Refer now additionally to FIGS. 3A and 3B, two views of fan 24 of FIG. 1. Fan 24 is preferably molded of plastic. Fan 24 has six preferably enclosed pockets 36. Each pocket 36 contains an insert-molded permanent magnet 38. Permanent magnets 38 can be of any known permanent magnet material, including but not limited to ferrite and rare earth magnetic material. An advantage of designing pockets 36 to fully enclose magnets 38 is that magnets 38 are then protected from corrosion during service in rotor 10. Each pocket 36 is located so that when fan 24 is assembled into rotor 10, a pocket 36 is pressed under a pole finger 22 of second pole piece 14 and above body 32 of first pole piece 12. This is preferably a very snug or interference fit.

CCOR:
310/263

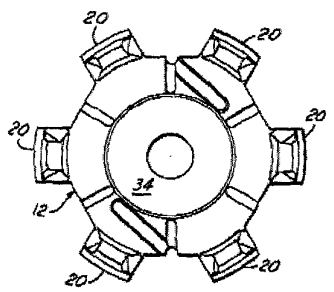

FIG.2A

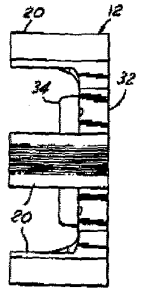

FIG.2B

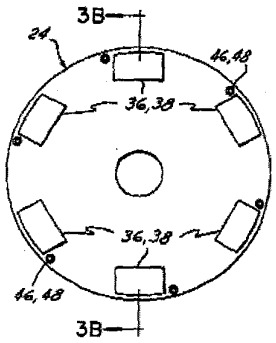

FIG.3A

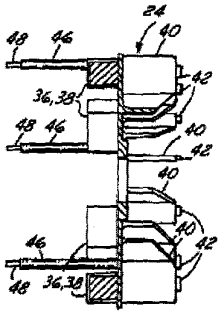

FIG.3B

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File Edit View Tools Window Help

DOCUMENT-IDENTIFIER: US 5779453 A
TITLE: Vacuum pump motor arrangement having reduced heat generation

---------- KWIC ---------

BSPR:
The permanent magnets of the motor rotors comprises a bonded magnet made of
mixture of magnetic powder and synthetic resin .

DEPR:
Further, in the present invention , since the permanent magnets 5a, 5b are a
bonded magnet composed of a mixture of magnetic powder and synthetic resin, the
eddy current is prevented from being generated in the permanent magnets 5a, 5b,
resulting in reducing the heat generated in the motor rotors 5A, 5B to a
minimum degree.

DEPV:
(3) Since the permanent magnets are a bonded magnet composed of a mixture of
magnetic powder and synthetic resin, the eddy current is prevented from being
generated in the permanent magnets, thus reducing the heat generated in the
motor rotors .

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US005779453A

United States Patent [19]
Nagayama et al.

[11] **Patent Number: 5,779,453**
[45] **Date of Patent: Jul. 14, 1998**

[54] **VACUUM PUMP MOTOR ARRANGEMENT HAVING REDUCED HEAT GENERATION**

[75] Inventors: Masami Nagayama; Katsuaki Usui; Kou Hatake; Yoshinori Ojima; Genichi Sato; Yasuhi Hisabe, all of Kanagawa-ken, Japan

[73] Assignee: Ebara Corporation, Tokyo, Japan

[21] Appl. No.: 778,499

[22] Filed: Jan. 3, 1997

Related U.S. Application Data

[63] Continuation of Ser. No. 618,117, Mar. 19, 1996, abandoned.

[30] Foreign Application Priority Data

Mar 20, 1995 [JP] Japan 7-087542

[51] Int. Cl.[6] F04B 35/04; F04B 53/08

[52] U.S. Cl. 417/410.4; 417/373; 417/410.3; 417/423.7

[58] Field of Search 417/373, 410.3, 417/410.4, 423.4, 423.7, 423.8, 423.14; 418/8, 209.1

[56] References Cited

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5,354,179	10/1994	Maruyama et al.	417/410.3

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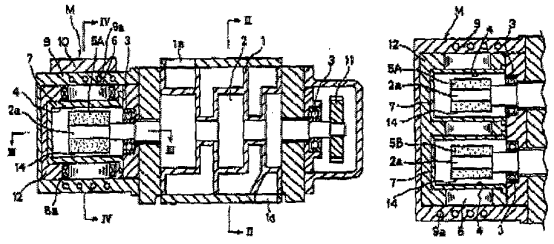
94 01 967	4/1994	Germany .	
59-97558	7/1984	Japan .	
4 17 8143	10/1992	Japan .	

Primary Examiner—Charles G. Freay
Attorney, Agent, or Firm—Armstrong, Westerman, Hattori, McLeland & Naughton

[57] **ABSTRACT**

A vacuum pump has a pump casing having a suction side where a suction port is located and a discharge side where a discharge port is located, a pump assembly housed in the pump casing and comprising a pair of pump rotors rotatable in synchronism with each other and having respective shafts, and a brushless direct-current motor mounted on the pump casing at a suction side of the pump casing. The motor has a pair of motor rotors comprising respective sets of permanent magnets which are mounted respectively on the shafts, a pair of cans surrounding outer circumferential and end surfaces of the motor rotors in sealing relation to the pump assembly, a motor stator mounted on the cans and housed in a water-cooled motor frame.

6 Claims, 4 Drawing Sheets



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DOCUMENT-IDENTIFIER: US 5705970 A
TITLE: Rare-earth containing iron-base resin bonded magnets

---------- KWIC ---------

ABPL:
A motor having rotor has a good balance of inertia and a magnetic
characteristic that match the specifications of the motor with which those
rotors are to be used. A rare-earth containing iron-base resin -bonded magnet
is molded from an iron-base magnetic powder containing a rare earth metal such
as neodymium and praseodymium in powder, a thermoplastic or thermosetting resin
and additive. A density and magnetic characteristic is proportionally changed
by adjusting a mixing ratio of a filler powder . Specifically, when a mixing
ratio of filler powder containing tungsten having a density 19.1 g/cm.sup.3 is
in 13 vol % is injected, or a mixing ratio of alloy powder containing tungsten
an nickel, or tungsten and chromium having a density 10.5 g/cm.sup.3 is
compression-mold, its magnetic flux assume the same value as those of
compression-molded Sm--Co magnets .

US005705970A

United States Patent [19]
Nishida et al.

[11] **Patent Number: 5,705,970**
[45] **Date of Patent: Jan. 6, 1998**

[54] **RARE-EARTH CONTAINING IRON-BASE RESIN BONDED MAGNETS**

[75] Inventors: **Shigeru Nishida**; **Takafumi Kuwamura**; **Tetsu Hoshina**, all of Nagano, Japan

[73] Assignee: **Kabushiki Kaisha Sankyo Seiki Seisakusho**, Nagano, Japan

[21] Appl. No.: 386,761

[22] Filed: Feb. 10, 1995

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 323,436, Oct. 17, 1994, abandoned.

[30] **Foreign Application Priority Data**

Oct. 15, 1993	[JP]	Japan 5-281970
Feb. 10, 1994	[JP]	Japan 6-16496
May 31, 1994	[JP]	Japan 6-140777
Jan. 6, 1995	[JP]	Japan 7-16480

[51] Int. Cl.[6] H01F 3/08
[52] U.S. Cl. 335/302; 335/306
[58] Field of Search 335/302-306

[56] **References Cited**

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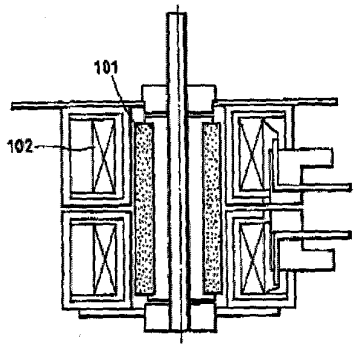
5,389,376	2/1995	Nakanishi et al.	156/242
5,414,395	5/1995	Baglini	335/179

Primary Examiner—Lincoln Donovan
Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak, and Seas

[57] **ABSTRACT**

A motor having rotor has a good balance of inertia and a magnetic characteristic that match the specifications of the motor with which those rotors are to be used. A rare-earth containing iron-base resin-bonded magnet is molded from an iron-base magnetic powder containing a rare earth metal such as neodymium and praseodymium in powder, a thermoplastic or thermosetting resin and additive. A density and magnetic characteristic is proportionally changed by adjusting a mixing ratio of a filler powder. Specifically, when a mixing ratio of filler powder containing tungsten having a density 19.1 g/cm³ is in 13 vol % is injected, or a mixing ratio of alloy powder containing tungsten an nickel, or tungsten and chromium having a density 10.5 g/cm³ is compression-mold, its magnetic flux assume the same value as those of compression-molded Sm—Co magnets.

18 Claims, 5 Drawing Sheets



fibers, and the
permanent magnets constituting the cylindrically arranged members are formed by molding and solidifying mixed powder of materials including at least iron, neodymium, samarium and cobalt, sintering the resultant product and magnetizing the sintered product. The outer cylinder is formed by melting a resin material and impregnating windings or woven cloths of carbon fibers or ceramic fibers with the resultant molten resin material.

DEPR:
In order to produce the segmental members 66 of permanent magnets, magnetic powder containing elements, such as iron, neodymium, samarium and cobalt is packed in a mold comprising semicircular or fan-shaped segments, and the resultant powder is solidified by compression molding the same at a high temperature to obtain molded bodies, which are then sintered while applying thereto a magnetic field so that magnetic poles occur in a predetermined direction, whereby lines of magnetic force are set in order. During this time, the molded bodies in the segments are set to shapes substantially identical with predetermined shapes prior to a sintering operation so that the molded bodies have high-precision final shapes. The segmental members 66 of sintered permanent magnets are then taken out of the mold.

DEPR:
A method of manufacturing permanent magnets constituting the rotor 75 will now

Details Text Image HTML KWIC

US006144130A

United States Patent [19]
Kawamura

[11] **Patent Number: 6,144,130**
[45] **Date of Patent: *Nov. 7, 2000**

[54] **STRUCTURE OF ROTOR FOR GENERATORS AND METHOD OF MANUFACTURING THE SAME ROTOR**

[75] Inventor: **Hideo Kawamura**, Kanagawa-ken, Japan

[73] Assignee: **Isuzu Ceramics Research Institute Co., Ltd.**, Kanagawa-ken, Japan

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: 09/009,894

[22] Filed: **Jan. 21, 1998**

[30] **Foreign Application Priority Data**

Jan. 21, 1997 [JP] Japan 9-020937
Jan. 21, 1997 [JP] Japan 9-020938
Mar. 3, 1997 [JP] Japan 9-047717
Mar. 4, 1997 [JP] Japan 9-063978

[51] Int. Cl.[7] **H02K 21/12**
[52] U.S. Cl. 310/156; 310/254; 310/261; 310/264; 310/266
[58] **Field of Search** 310/156, 254, 310/261, 258; 29/596, 598

[56] **References Cited**

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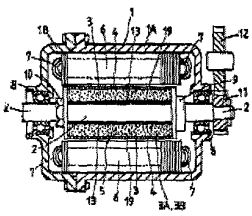
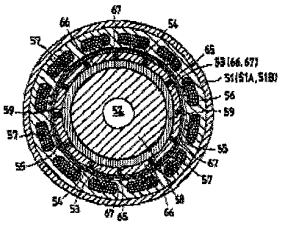
Primary Examiner—Elvin Enad
Attorney, Agent, or Firm—Browdy and Neimark

[57] **ABSTRACT**

The present invention provides a structure of a rotor for a generator in which a rotor capable of being ground very easily with a high accuracy is incorporated. This structure of a rotor comprises a rotor mounted fixedly on a rotary shaft supported rotatably on housings. The rotor comprises cylindrically arranged members in which segmental members of permanent magnets are assembled together cylindrically, and an outer cylinder provided on an outer circumference of the cylindrically arranged members and comprising windings or woven cloths of fibers. A resin material capable of being ground is packed in clearances between the cylindrically arranged members and outer cylinder and in the clearances in the outer cylinder.

23 Claims, 6 Drawing Sheets





Details Text Image HTML Full

Ready NUM

As the permanent magnets used in the present invention can be produced by conventional methods such as a powder metallurgy method, a plastic working method (swaging, extruding, rolling and so on), a bonded magnet method, a casting method, and a ultra-rapid cooling method. For forming the permanent magnets of the invention, there can be used at least one conventional permanent magnet material selected from the group consisting of a rare earth element magnet material, an Alnico magnet material, a Mn--Al magnet material and so on.

Such rare earth element magnet material is composed of R--Fe--B alloy, Sm--Co alloy, or Sm--Fe--N alloy (R is at least one selected from the group consisting of rare earth elements containing Y, and there may optionally be contained at least one element effective for magnetic properties, which is selected from the group consisting of Co, Al, Nb, Ga, Fe, Cu, Zr, Ti, Hf, Ni, V, Si, Sn, Cr, Mo, Zn, Pt, Bi, Ta, W, Sb, Ge and Mn. Further, there may be contained at least one incidental impurity element selected from the group consisting of O, C, N, H, P and S). Also, the permanent magnets of the invention may be formed mainly by powder (particles) of at least one selected from the above permanent magnet materials, and a conventional thermoplastic resin, or a conventional thermosetting resin, or a conventional rubber material, namely a conventional bonded magnet (preferably, an anisotropic bonded magnet) containing the above

Details | Text | Image | HTML | KWIC

US005684352A

United States Patent [19]
Mita et al.

[11] **Patent Number: 5,684,352**
[45] **Date of Patent: Nov. 4, 1997**

[54] **PERMANENT MAGNET FIELD-TYPE ROTATING MACHINE**

[75] Inventors: Masahiro Mita; Takashi Sasaki, both of Fukuya, Japan

[73] Assignee: Hitachi Metals, Ltd., Tokyo, Japan

[21] Appl. No.: 628,845

[22] Filed: Mar. 20, 1996

[30] **Foreign Application Priority Data**

Mar. 24, 1995 [JP] Japan 7-065518
Mar. 6, 1996 [JP] Japan 8-048969

[51] Int. Cl.[6] H02K 21/12
[52] U.S. Cl. 310/156; 310/152; 310/251
[58] Field of Search 310/152, 153, 310/155, 156, 157, 261, 262; 360/99.08, 98.07, 99.04, 97.02

[56] **References Cited**

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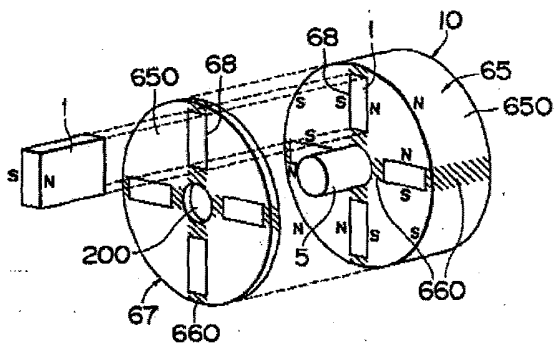
7-169073 6/1995 Japan .

Primary Examiner—Clayton E. LaBalle
Assistant Examiner—Timothy A. Williams
Attorney, Agent, or Firm—Finnegan, Henderson, Farabow, Garrett & Dunner

[57] **ABSTRACT**

Disclosed is a permanent magnet field-type rotating machine of a high efficiency having an internal magnet-type rotor. The rotating machine comprises an internal magnet-type rotor having a plurality of permanent magnets embedded in a rotor yoke, and a stator disposed in opposed, spaced relationship to the rotor, with an air gap formed between the rotor and the stator. The rotor yoke comprises a member in which ferromagnetic regions and non-magnetic regions coexist, and the non-magnetic regions are disposed respectively at those positions of the rotor yoke where leakage magnetic flux is liable to be generated.

20 Claims, 9 Drawing Sheets



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DOCUMENT-IDENTIFIER: US 5800728 A
TITLE: Permanent magnetic material made of iron-rare earth metal alloy

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DEPR:
The formed ingot was annealed at 900.degree. C. for seven days and crushed in
an iron mortar and then crushed in a ball mill in the organic solvent particle
size of about 10 .mu.m. In order to permeate nitrogen in this powder, the
powder was thermally treated at approximately 550.degree. C. in nitrogen gas
(N.sub.2). As a result, 1.68 wt % of nitrogen was included in the material.
Thus, the ratios of the components of the material were 72.2 wt % Fe, 19.4 wt %
Sm, 5.91 wt % Ti, 0.423 wt % C, 0.381 wt % B and 1.68 wt % N, respectively,
that is, the atomic ratios of the components of the material, Fe, Sm, Ti, C, B
and N were 74.5%, 7.45%, 7.11%, 2.03%, 2.03% and 6.91%, respectively.

US005800728A

United States Patent [19]
Iwata

[11] Patent Number: **5,800,728**
[45] Date of Patent: **Sep. 1, 1998**

[54] **PERMANENT MAGNETIC MATERIAL MADE OF IRON-RARE EARTH METAL ALLOY**

[75] Inventor: Masao Iwata, Sakata, Japan

[73] Assignee: Hitachi Metals, Ltd., Tokyo, Japan

[21] Appl. No.: 468,333

[22] Filed: Jun. 6, 1995

Related U.S. Application Data

[63] Continuation of Ser. No. 125,611, Sep. 7, 1993, abandoned, which is a continuation of Ser. No. 772,303, Oct. 7, 1991, abandoned.

[30] Foreign Application Priority Data

Oct. 5, 1990	[JP]	Japan	2-267726
Oct. 11, 1990	[JP]	Japan	2-272742
Nov. 13, 1990	[JP]	Japan	2-305589
Nov. 13, 1990	[JP]	Japan	2-305590
Nov. 13, 1990	[JP]	Japan	2-305591
Nov. 13, 1990	[JP]	Japan	2-305592
Sep. 13, 1991	[JP]	Japan	3-234913

[51] Int. Cl.[6] C04B 35/64; H01F 1/057
[52] U.S. Cl. 252/62.55; 148/302; 420/83; 420/416; 420/126
[58] Field of Search 148/301, 302; 420/83, 121, 416, 126; 252/62.53, 62.54

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(List continued on next page.)

Primary Examiner—John Sheehan
Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas, PLLC

[57] **ABSTRACT**

An iron-rare earth metal permanent magnetic composition, comprising predominant phase having a body-centered tetragonal structure, and consisting essentially of an iron-based alloy having a composition represented by the formula:

$$Fe_{100-a-b-c-d-e-f-g}M_aB_bC_cN_dO_eH_fX_g$$

wherein R represents at least one element selected from the group consisting of Y, Th and the lanthanide elements;

M represents at least one element selected from the group consisting of Ti, Cr, V, Zr, Nb, Al, Mo, Mn, Hf, Ta, W, Mg, Si, Sn, Ge and Ga;

the elements are present in atomic percentages indicated by a, b, c, d, e, f, g and h, wherein a+b+c+d+e+f+g+h=100 atomic %; and further,

$3.5 \le a \le 30$

$0 \le c \le 30$

$0 \le d \le 50$

$0 \le e \le 50$

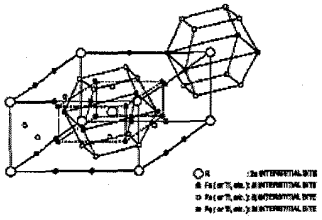
$0 \le f \le 50$

provided that $0.3 \le d+e+f \le 50$

$0 \le g \le 50$ and

$0 \le h < 30$.

2 Claims, 1 Drawing Sheet



US-PAT-NO: 6307297

DOCUMENT-IDENTIFIER: US 6307297 B1

TITLE: Recessed alternator pole piece

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Detailed Description Text - DETX (8):

Permanent magnets 40 are disposed beneath the claw fingers and between the claw fingers and the rotor coil 30. (For simplicity and ease of presentation, the magnets 40 are not shown in FIGS. 4-7.) Preferably, the magnets are located near the tips of each of the pole claw fingers and held in place by an epoxy adhesive. Also preferably, the magnets 40 do not extend beyond the pole claw fingers. Magnets 40 are thus supported by solid iron magnetic circuits on both sides thereof which provide the requisite flux conducting path.

Current US Original Classification - CCOR (1):

310/263

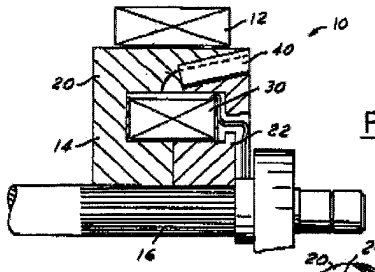

FIG.1

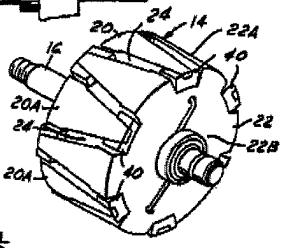

FIG.2

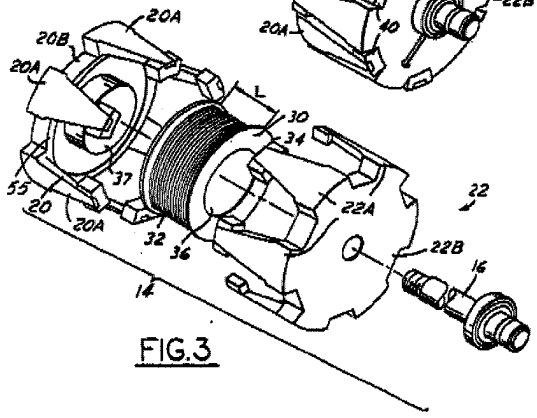

FIG.3